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AUTHOR Geoffrion, Leo D.; Bergeron, R. Daniel
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ABSTRACT

The Computer Animated Reading Instruction System (CARIS) was developed to introduce reading to children with varied sensory, cognitive, and physical handicaps. CARIS employs an exploratory learning approach which encourages children to experiment with the reading and writing of words and sentences. Brief computer-animated cartoons provide the child with visual feedback of the meaning of sentences constructed by the child. Pilot experiments show that children with varied learning handicaps can develop beginning reading skills through use of this system. The possible implications of such systems to current models of reading readiness and psychometric testing are briefly mentioned. (Author)

Initial Reading Through Computer Animation

by

Leo D. Geoffrion
Department of Education

R. Daniel Bergeron
Department of Mathematics

University of New Hampshire
Durham, New Hampshire 03824

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Initial Reading Through Computer Animation

This paper presents the first of a series of experiments designed to explore alternative approaches to the teaching of beginning reading to children with severe communication and learning handicaps. Handicaps such as childhood aphasia, deafness, mental retardation, and cerebral palsy sufficiently impair a child's communicative competence that academic instruction through conventional means has been largely ineffective.

The Computer Animated Reading Instruction System (CARIS) is designed to develop beginning reading and language skills through the use of computer-generated visual displays. The system provides a highly stimulating environment in which children learn to read by directing the computer to make simple brief animated cartoons. CARIS provides a responsive environment in which a child with poor communicative skills can nevertheless control a system with relative ease and through this control develop initial reading skills.

Rationale

Among the most fundamental needs of human beings is the ability to express one's own ideas and feelings and to understand those of others. Communication is the basis for cognitive and emotional growth.

Perhaps the most universal characteristic shared by handicapped individuals is the inability to communicate effectively through conventional symbol systems. Various handicaps differ as to the locus of the communication breakdown, but once broken, the results of a lack of communication are very similar across handicaps.

The most visible result of a communication breakdown is the failure to learn the symbol systems used by other people. Without the complete feedback loop, children are slow to learn the vocabulary and syntax of English. A less obvious but equally debilitating effect of communication breakdown is the way that a handicapped child quickly loses interest in surrounding activities, particularly those involving interaction with other people. The child appears to withdraw into a private world with little interest or concern about the activities of others. Indeed Van Lint's autobiography (1975) of her adaptation to paralysis suggests that this passivity is a learned response to the inability to communicate efficiently.

Another striking result of a communication breakdown is its effect on those people interacting with the child. Without communication, the handicapped child is often treated almost like a nonperson, incapable of judgement or reason. This destructive interaction is obvious not only for children who are born with communication handicaps but also for adults who lose the ability they once had.

The first step in the education of these handicapped individuals is the development of effective communication skills. The optimal technique to achieve this is to emphasize exploratory learning in a responsive environment. In such an environment the child has the opportunity to manipulate a system, form predictions based on that experience, and then test those predictions. Through such interaction the child learns to master the feedback loop that is fundamental to communicative competence.

Existing Systems

Edison Responsive Environment. The oldest computer-based system for promoting exploratory learning of reading has been the Edison Responsive

Environment, more commonly known as the "talking typewriter" (Moore, 1956). The system is based on a computer driven typewriter and audio response system that uses four stages for promoting reading and writing skills.

Studies of the effectiveness of the talking typewriter with the mentally retarded (Moore, 1956), autistic (Goodwin & Goodwin, 1969), culturally disadvantaged (Logan & Fleming, 1973), and reading disabled children (Pines, 1965) have been very encouraging. The principal disadvantage of the talking typewriter is that it builds to reading words from extensive practice identifying individual letters. While this synthetic phonic approach is clearly effective for normal children (Chall, 1967), it is not the best approach for all children, particularly those with severely deficient language backgrounds. For these children it might be better to begin with brief meaningful messages and only provide a transition to alphabetic manipulations later.

PLATO. The PLATO system developed at the University of Illinois is a general purpose computer-based instruction system which includes a reading project (Obertino, 1974; 1975) that combines both exploratory learning and drill-and-practice approaches. Data on the effectiveness of the reading project has not yet been released but preliminary results suggest considerable excitement concerning the value of their exploratory activities for helping young children to read. While experiments are now being conducted in the use of PLATO with handicapped children, there has been no attempt yet to adapt the system to the special needs of these children.

LOGO. Another outstanding system designed for normal children but recently adapted to the handicapped is the LOGO system developed by the Massachusetts Institute of Technology. LOGO is unique among computer-based educational systems in that it has no curriculum *per se*. LOGO is a general purpose computer language that is simple enough to allow very young children to become engaged in the thrill and challenge of teaching the computer to perform various feats such as picture drawing, puzzle solving, and game playing (Papert & Solomon, 1972). Most of the learning activities within the LOGO system have focused on developing mathematical and logical problem solving skills. There has been little emphasis on learning activities for reading and typing skills other than for words needed to control the system.

Recently the LOGO project has begun to explore the value of LOGO for handicapped children. Through special terminal adaptations, even children with severe physical handicaps have been able to operate the system successfully. Case histories of these children using LOGO provide dramatic examples of the power of exploratory learning approaches (Goldenberg, 1976; Weir & Emanuel, 1976). When presented with a system they can control and manipulate, even children with severe handicaps soon become engrossed in the fun of trying to make the computer perform a desired action. At the same time they are learning cognitive skills which are more sophisticated than many had assumed them capable of learning.

The CARIS System

CARIS is designed to operate eventually using a low-cost microprocessor based computer system. Such a system will be sufficiently inexpensive and portable to allow its installation in special education centers and similar institutions. This first version has been developed on a Digital Equipment Corporation PDP11/40 computer with a VT11 graphics display.

The CARIS system uses three phases to introduce reading to handicapped children. This paper will discuss mainly the first two stages, since the third stage is not yet implemented in this prototype.

The CARIS prototype system is designed to provide a child with three distinct phases which require increasingly more reading competence.

Introductory phase. When the child is first introduced to the system he/she is presented with a display containing about five words (nouns) printed on the screen. The child learns that he can select a word by touching a light pen to that word. When this happens, the nouns immediately disappear and the picture representing the word selected occupies the center of the screen. On the left of the screen are five new words (verbs). When the child selects one of these verbs, the figure on the screen acts out the intended meaning of the verb. After the animation is complete, the noun list reappears to allow a new selection.

As the child becomes more familiar in recognizing the words, additional words are added until the complete lexicon is available to the child. In all cases, however, the child can choose the desired word by simply touching it with the light pen.

The system is designed to be tailored to the needs and abilities of each child. For any child, the number of words and the particular words used can be controlled. Even the child's name can be added to the system lexicon if desired. Words can be added to or deleted from a child's word list at any time.

Intermediate phase. Once a child is familiar with the use of the system, the system can be shifted to the intermediate phase of operation. In this mode, the ordering of the words within the noun and verb lists is randomly rearranged on each trial. Thus the student must attend to the word itself rather than any positional cue in choosing a word. During later portions of the intermediate phase, the animation is deferred until the student chooses a complete noun, verb sentence. This is done to ease transition to the spelling phase and to encourage children to think of communicating in more complete sentences. As before, however, words are chosen by merely touching them with the light pen.

Spelling phase. After the child has become proficient in forming sentences, the spelling phase is introduced. In this phase the light pen response for choosing words is no longer accepted by the computer. Instead the child must spell the word to use it. Not all words will convert to the spelling phase simultaneously in order not to frustrate the child. To provide the child with a smooth transition between sentence mode and spelling mode, the child first chooses the word desired using the light pen. The computer then requests that the child spell out the word. Since the computer knows which word is intended, it can help by ignoring incorrect letter choices or by providing other clues. Since this phase is still under development, its effectiveness has not yet been evaluated.

Evaluation Design

Because of the exploratory nature of this first attempt at developing a computer-based reading system for handicapped children, a case history approach was adopted in place of more formal designs. This evaluation is still underway. To date ten children with varied communication and learning handicaps have operated the system for a total of thirty-six sessions. An individual session typically lasts from 15 to 25 minutes.

The ten participants were chosen to represent a varied range of learning handicaps. All diagnoses were taken from school records and interviews with their teachers. The major handicapping conditions found in this sample are:

Mental Retardation	3
Severe Learning Disability	2
Deafness	2
Developmental Aphasia	3

All participants are receiving some form of reading instruction from their schools, but have thus far been unsuccessful in learning to read. Since the children come from many different schools, the instructional techniques used by their schools are varied.

All participants were pretested and will be post-tested at the end of the evaluation using two reading tests. The first is an informally constructed CARIS Vocabulary Test, consisting of twenty-three plates on each of which one word is printed and four pictures are provided. The child must read the word and choose the picture which matches the word. The words chosen for this test match as closely as possible the CARIS lexicon. The second test is the Word Identification Test from the Woodcock Reading Mastery Tests (Form B). Since there is little correspondence between the words in this test and the CARIS lexicon, this test is used to measure any spontaneous generalization of reading skills to other words.

In addition to these tests, the computer system automatically maintains records of all student responses and the latency of their responses. Many sessions are videotaped to permit detailed analysis of student behavior.

Results

Since the evaluation is still underway, the findings discussed herein are tentative. Nevertheless the system has already demonstrated some of its versatility for handicapped children. Before discussing general conclusions from using the system with children, summaries of two case histories will be presented to illustrate the range of behaviors typically observed.

Case 1: Fred*

Fred, a seventeen-year-old mentally retarded teenager, works in a sheltered workshop. In the workshop he receives some training in reading and mathematics in addition to working at various forms of unskilled labor. Prior to joining the workshop last fall, he had received several years instruction in reading using DISTAR and other programs.

In the pretest, Fred correctly read thirteen words in the Word Identification Test of the Woodcock (grade level 1.5). On the CARIS Vocabulary Test he correctly identified 12 of 23 words. Outside of reading he is alert and communicates well, although with a narrow range of interests.

Thus far, Fred has used the system seven times, and is continuing to visit the project weekly. He started using a lexicon of five nouns and verbs, but has now grown to being able to use the full lexicon. Fred works on the system with quiet concentration and with no signs of boredom or lack of interest.

Fred's behavior using the system is very interesting in that he is more clearly systematic in his selections of words than most users. Frequently he will select a particular verb and then practice it in combination with various nouns.

He seldom speaks when using the system, but his lips move whenever he chooses a word from the displays. A microphone placed on the terminal revealed that he was quietly practicing each word as he selected it. Several

*All names are fictitious to protect privacy.

times he would correctly identify the word before the picture appeared to identify the word. Thus it is clear that he is reading the words.

Fred is nearly at the point of consistently identifying all words in the CARIS lexicon correctly. As soon as the spelling phase of the system is operational, he will move into more advanced reading activities.

Case 2: Elizabeth

Elizabeth is a quiet, unassertive young girl with developmental aphasia. She never speaks, and it is unclear how fully she understands the speech of others. She responds to requests sporadically, sometimes showing good comprehension and at other times not. She seldom smiles or laughs, and avoids interaction with teachers and other staff. Nevertheless she is alert to activities taking place around her.

In the pretest, she correctly identified seven of twenty-three words in the CARIS Vocabulary Test. No meaningful results were possible from the Woodcock because of her expressive language disability. Elizabeth has thus far participated in three sessions using the system.

In the first visit she had some difficulty in understanding the system operation and needed coaxing to choose a word from the lists. Whenever a picture appeared on the screen she would spend much time tracing the outline of the picture with considerable accuracy before choosing a verb to animate the picture. She would then move briefly to the verb list, but if the system failed to respond because she missed pointing to a word, she would return to tracing the picture. Her word choices were almost always the same ones.

Over the next two sessions, her proficiency in using the system rapidly increased. By the third session she clearly understood the light pen operation and began using it at the start of the session without any prompting by the staff. When using the system Elizabeth frequently glances over to project staff and her teacher and sneaks out a gentle smile. Occasionally she laughs when the animation is particularly incongruous (e.g. "DOG FLIES"). As she uses the system, she gradually becomes more expressive in her enjoyment of it.

During her second visit, she still restricted her choices to a few words. This is not simply a response perseveration since the words in the display are randomly rearranged on each trial. Thus she must discriminate her desired words from others in order to identify them. By the third session, her choices were much more varied and she began to explore various word combinations in a more systematic manner. During this third session her reading skill was informally assessed by asking her to generate various combinations. She could accurately select among the nouns on her list, but was still unsure about the verbs.

In future sessions, the size of her lexicon will be increased gradually until she has mastered the full system lexicon. Meanwhile both her teacher and her parents are pleased by her newfound reading ability.

Findings

Although the evaluation is still underway, our experience has already indicated several important points in the design and operation of exploratory learning systems such as CARIS. These points include:

1. The CARIS system is sufficiently simple and interesting to allow its use with severely handicapped children.

Children with varied handicaps have used the system with considerable interest and enthusiasm. All have learned how to operate the system after brief exposure to it.

2. In the future greater variety of activities is needed than the basic CARIS ani

While children enjoy operating th hildren who have used it for more than six sessions appear t in their interest. While CARIS is good for getting children started, additional activities will be needed to continue reading growth. Furthermore, cartoon generation is intrinsically limited only to those words which can be visually represented.

3. Activities must be designed to train generalization of reading skills to new words and other situations than computer animation.

Most children learn to identify several new words by using the system, but this learning is specific to the CARIS lexicon. Considering that the system provides no training in word attack skills, this outcome is predictable. Such activities would be needed before field implementation of such a system.

4. Children must be provided freer access to such a system if it is to prove effective.

Our experience shows that the optimal use time for most children are sessions lasting 15 to 25 minutes. For such brief sessions to be effective, children must have daily access to the system rather than weekly visits as is currently done.

Implications

The success of projects such as this raises several questions about current assumptions in special education.

One major question is a redefinition of exactly what constitutes reading readiness. This project along with others (e.g. Fuller et al, 1972) have demonstrated that children who are normally considered unready for reading instruction are capable of learning to read if techniques are adapted accordingly.

Specifically, CARIS assumes no prior mastery of English phonology and no particular interest in books or words by the children. Are these distinct skills which must be mastered before a child can learn to read, or are these limitations merely artifacts of our instructional technology?

Traditionally a deaf child's reading proficiency is limited by that person's proficiency with the English language. Can exploratory learning systems like CARIS provide the child with adequate visual experiences to facilitate a child's language development? Already CARIS has provided a medium for teaching the meaning of verbs to deaf children which is more powerful than conventional approaches.

Can exploratory learning systems provide a more adequate approach to psychometric assessment for communication handicapped children? More traditional approaches to testing are based on the assumption that the child is interested in bothering to answer questions or problems posed by an examiner. This assumption is very questionable when testing is undertaken with communication handicapped children. Exploratory learning systems provide an environment wherein the child is more easily induced to demonstrate his or her cognitive skills. One of the universal findings among projects like CARIS is that handicapped children often perform far beyond what others had thought them possible of doing. Might such systems then be a better indicator of a handicapped child's potential?

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